P R O V O R I V E R.

1. The writer in a former report to the Court in this cause gave an illustration of the return flow to the Provo River, and then stated:

"From this fact it will be seen that the lower portion of the Provo River, depends largely upon the extent of irrigated area and the amount of applied water in the Provo Valley, and the Provo Valley is by the past practice, and can be in the future by proper manipulation of the waters of the Provo River, the storage reservoir of the lower river and the Utah Valley."

When the case came up for hearing and for the arrangement of a working basis for the year 1915 an order was issued that gave to the Commissioner the power of "Proper manipulations" or more properly speaking the order did not restrict the commissioner from using the high waters in large quantities on the upper stretches of the river.

2. Realizing fully the scant snowfall during the preceeding winter, the diminished flow of springs, and the lowness of the ground water plane; the commissioner took charge of the Provo on the first day of April with apprehensions of the outcome, and with a doubt that it might not be possible to mature all the crops on the Provo, with these conditions the commissioner decided on the one way and only way to insure an amount of water to the water users that would maintain a river in the months of the low season.

3. And therefore in the flood season an attempt was made to use on the upper valleys, regardless of the discharge in the Utah Valley, enough water to fill the natural storage basins and raise the ground water plane to normal height, for to this storage the lower river in July, August and September must depend. This plan was followed through the Spring and early summer season and when we came to the low stage on June 25th, it was felt that we were fairly well able to supply a sufficient amount of water to the lower river.

During the low period of May this plan was open to all the criticism that ordinary water users can muster, now after more mature thought, and after seeing the results, we appreciate the change of opinion.

4. This season has demonstrated the fact that; a drainage area is one unit and inseperable, that should be directed under one head along a line that is sure to give the maximum of efficiency, and along a line that will tend to increase its output, and develop all its possibilities. This season has further demonstrated that the Provo River is a dependable stream--not a dry wash in one day and a raging torrent in another, but a steady continous flow one year with another, and nearing uniformity in the season of need.

5. And again when we consider that the Provo stood out as an exception over the rivers in the West in its discharge during the season of low flow, giving maturity to all crops and when on August 11 it was delivering 88 per cent of its mean, and again on August 18th, the time of minimum mean it was delivering

93 per cent of the mean, we almost voice admiration and we cease to remember this stream as a back yard creek of less than 150 second feet in the summer of 1885.

6. Viewing this system with the records available and the advantage of long acquaintance and study, I can see of no reason why the adjudicated river should not approach very nearly to the mean river.

Discriptive. 7. The bedrock of the Provo River Watershed forms a corrugated surface consisting of more or less parallel ridges and narrow intervening canyons, with valleys along the main course of the stream.

Excepting the upper 10 miles of the main Fork, the canyons and valleys are filled to great depth with rock waste washed from the mountains. These great deposits of rock waste were in large part laid down by torrential streams, and are relatively coarse and porous. Because they are porous, they allow the rains that fall, the run-off from the mountains, and the irrigation water to sink into them, and consequently the portions of the valley, which they underly, in their natural state presented a desert aspect, but now to the extent of irrigation and to the raising of the ground water plane, they are covered with farms and meadows.

8. These deposits are great water conservers, for they constitute huge reservoirs, in which the supply received by percolation, run-off, and irrigation is stored, and to the limit of the capacity of the reservoirs is protected from evaporation, and is conserved for release at a lower level in the period of scant flow.

9. Contributions to the valley fill are made by the

permament streams that flow from the canyons and applied by irrigation, the floods from the canyons that are normally dry, the underflow from some of the canyons, from springs and underground openings in the rocks, and a small amount from the precipitation that falls in the Valley.

10. All the canyons, in the spring time carry large amounts of flood waters that are valuable contributions to the storage in the underground fill, and the refilled canyons carry in their subsurface channels along the bedrock quantities of water that joins the main body of water in the valley without comming to view. The existance of an underground flow is demonstrated in many places, where, owing to some underground obstruction, the water is compelled to return to the surface, producing springs swampy areas, and a material increase in flow as in Deer Creek, at the crossing of the pot rock ridge across the canyon.

The summer precipitation in the Valleys is absorbed by the capillary pores of the soil and does not make any contributions to the underground storage, but the heavier rains, and the melting of the snows that produce streams, enter the earth wherever the soil is porous.

11. The Provo heading in a range of mountains that have a season of winter precipitation with runoff ceasing near early summer, it transfers dependence from runoff to the storage in the earth. Where we find the formations that permit of precipitation entering into the soil, the fill, and crevices of the rocks, we find perennial streams and dependable outflow in the normal low water season,

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this condition is true of Vivian Fork (South Fork Provo Canyon) Snake Creek, Wildwood Fork, Deer Creek, South Fork, and Little South Fork, and where we find the formations adverse to water entering into the earth or with the outlet opening to another watershed we find a quick runoff and a low and non-dependable flow in the summer season, this is true of the upper section of the main Fork of the Provo.

12. The main Fork of the Provo above the junction of North Fork, is a dry canyon, it is not a refilled canyon, the whole is a rock mass, impenetrable to large quantities of water and discharging its snowfall in the floods of spring and early summer. The formation is sanstone rock with a very shallow earth covering. At the head the strata dips to the North and West to a foreign watershed, these stratas are cut by numerous vertical seams, crevices and fissures, the direction of this dip does not incontrovertably mean that all of the waters taken into the earth flow along the bedding planes, this thought was in mind at the time of the examination of this section and the vertical openings were studied, with but one exception I found them closed as shown by photo No.9. Photo No. 1 was taken from Mt. Bald- follow the dip from the Haystack Mountain to the divide and Weber watershed, also notice the dip on photo No.3 taken near Long Lake, and looking North seventy degree East, this is also illustrated by photos No.5,6,7 and 8 and Nos. 2 & 4. Photos No. 2&4 are of the channel from Washington Lake to the creek below Trial Lake the dip is 8 degrees to the North and 11 degrees to the West, and the walled cliffs West of the Southwest corner of Wall Lake dip 10 degrees to the West and 12 degrees to the North.

13. In direct distinction to the adverse dip the formations of the plateau lying east of the Haystack Mountain at its southern extremity is lying almost horizontal and the section between the main Fork of the Provo and the Duchesne also lies horizontal; this section covers the South Fork and Little South Fork.

14. With this thought of the dip in mind you may ask the question. How do you know these waters do not reach the river through subsurface channels? In answer to this question I submit photo No. 10,--the canyon, in the main fork of the Provo is not a refilled canyon, and we do not receive a substantial flow from this fork except the runoff, and storage.

15. Down the main fork some 12 miles from the head the canyon widens out and we have not meadows of grass and heavy timber growth; but only the sagebrush, an arid plant, that denotes no presence of water, this section of the canyon down to where irrigation begins is a sagebrush waste, with a narrow margin of willows along the creek bank.

16. Not far below where irrigation begins we see the first signs of the return of waters and the inflowing seepage from water applied above, and at Moons well at Woodland on August 26, 1915, the water plane being but five feet below, the surface and a quarter of a mile below the water plane at the surface.

17. Photo No. 11 was taken near Moon's well looking up the canyon note the sagebrush in the foreground this point is the dividing line between the filled and unfilled water basins of the upper river, and by photo No. 12 and 13 you may see the sagebrush flats near the Mouth of Shingle Creek.

18. From the diversion of water to the Kamas Bench by two canals we derive a return from this source and which is very plainly visible on the ground; there is an empervious plane 20 feet below the top of the south end of the Bench and dipping toward the Provo meeting the bottom of the Canyon at Larks, many places along this line we derive substantial flows notably at Lemons and Spring Hollow (Photo No. 14)

19. This condition of returning water is visible all along the river where irrigation is practiced, except the stretch between the Wasatch Dam and the Lower Midway Dam, the ground water plane at Smiths well (two miles below upper Midway Dam) during 1915 ranged near 12 feet, but along this stretch the Mill Pond springs arise and the Sagebrush and Spring Creek Canal has its heading and derives its supply from returning waters and seepage. The depth of the water plane at the Smith well does not mean that even this water does not eventually come to the surface farther down the river and by its constant depth it may move slower and denotes a more dependable supply than were it subject to erratic fluctuations. Over this stretch of river a season of long time high water stage produces a greater inflow than the season of 1915.

20. Where we pass the section of large irrigated areas our inflow increases and we are able to see mile by mile our enlarging river. This is shown by inserting the flow on a date this season as follows: The discharge on August 25th below the Lower Midway dam was 24.08 second feet, at Charleston Bridge 95.21 second feet, at Hoover's Ranch in the head Provo Canyon 136.43 second feet, at the U.S.G.S. Station in Provo Canyon 168 second feet, and including the South Fork and inflow below the U.S.G.S. Station 268 (Approx-

imate) second feet, these quantities include the Provo Reservoir Company and Sego Irrigation Company water, Deer Creek of 12 second feet and Wildwood Fork of 10 second feet, Vivian Fork 27 second feet. The lower charleston Canal was diverting 10.7 second feet and the Pioneer Ditches 5. second feet.

21. The inflow exclusive of mountain streams was as follows: Lower Midway Dam to Charleston Bridge 81.83 second feet in a distance of three miles; Charleston bridge to Hoovers 46.22 second feet, in a distance of 5 miles; Hoovers to the U.S.G S.Station 10 second feet, in a distance of 5 miles; U S.G.S.Station to the several points of intake of the canals in the Utah Valley 65 second feet; a total of 203 second feet. Photos No. 15,16,17 and 18 are illustrative of formation and increasing flow.

22. Now that we have thought of inflow in our minds, and have firmly established the benificial results of application of water on the upper stretches of the river we turn to the question of storage of flood waters at the head of the river.

The Union Reservoir Company is owned one-half by the Provo Reservoir Company and Sego Irrigation Company and which used their water in the Utah Valley, and one half by the Wasatch Irrigation Company and the Timpanogos Irrigation Company which use their water in the Provo Valley

23. These reservoirs are filled with flood waters, unappropriated waters of the Provo river, and when the river has receded in volume not sufficient to supply the owners of the reservoirs with sufficient

water for irrigation these bodies of water are tapped and comingled with the natural waters of Provo River and reclaimed at the respective points of diversion of the owners.

24. And when the Wasatch Irrigation Company and the Timpanogos Irrigation Company have not sufficient of natural flow, by the addition of the storage water they maintain upon their lands the application of large quantities of water as long as the storage supply lasts; it is this water that I wish to call your attention to; as soon as the application of water on the lands in the Provo Valley begins to diminish, then our ground water plane begins to recede, and our lower river shows an amber-color, a lowering of the adjacent plane, and by the use of this storage water in the Upper Valley we prolong the season of storing in this valley and approach nearer to the season of time when the Utah Valley is dependant on this storage. "It is possibly a fact that water used on the higher lands of the upper river in the early season flows through a number of the systems before doing it's final duty in the Utah Valley" (Wentz Report 1914) this extract very clearly sets out the thought under discussion, and I now add--- and the storage water used by the Wasatch and Timpanogos is delivered with very little diminution to Utah Valley at the time of greatest benefit, the Month of August.

25. Following is list of observations on Montgomery Cellar which is located near the center of the Provo Valley;

May 28--- 3.8 feet to water.

June 5--- 3.3 " " "

June 19---1.9 feet to water.
June 23 water running out of well for past three days, this well is near the point of observation at the cellar.
July 24--- 1 foot to water.
August 1 3.6 feet to water.
August 23 Cellar dry.

You will find in the files submitted with this report other observations on the ground water plane, the above is sufficient to set forth the thought desired to be conveyed.

26. It would indeed be a pleasure for the writer to submit in this report, the total amounts of water used on the sections of the river and the corresponding returns, but with the economical desires and lack of interest by the parties in this case this branch of the work was barely touched upon this season.

STORAGE RESERVOIRS:

27. The report of Mr. Pratt, which is inclosed herewith, very ably gives the data regarding the reservoirs at the head of the river, for this season the one question regarding the natural outflow from these basins seems to be the vexing problem, whatever this might have been were the reservoirs now in their natural state must be determined on the governing points of structure and the evidence gathered of the outflow before the dams were built, and by actual tests.

28. Customerly it has been the practice to determine the natural inflow to these lakes and charge that amount as natural outflow, without a series of tests as to the behavior of t'e lakes with the outlet valves closed this seemed to be plausible, no information was available regarding this quantity.

29. Heretofore the dip of the planes has been called to your attention. These planes are not broken but traverse across the whole section of the lake district as shown by photo No. 1. It is very true that the planes in their downward course pierce the subsurface sides of the lakes, and may be discharging quantities of water even greater than the quantities following the planes on the opposite side of the lake; this assumption is not true when we call to mind that Wall Lake, with its outlet valve closed for fortysix hours receded at the rate of 0.45 second foot: and Trial Lake with its outlet valve closed for 146 hours receded at the rate of 0.86 second foot; a Total loss of 11.56 acre feet, and all the inflow.

30. The opinions on this problem are merely conjectures the facts should be determined by the actual tests with closed valves or with careful measurements.

31. At any and all stages of height of water in these lakes, we do not find in the near vicinity in the Provo Watershed great gushing springs or a substantial inflow

The imaginative mind that can trace the seeps to the lakes above, might also deduce, the results of the continued source of supply and the intensity of pressure caused by the storage quantity.

32. The quantity of inflow or outflow to the reservoirs is not an essential factor at this time, the writers only object in mind is to call attention to the fact that tests should be made from time to time in each season to determine the actual quantities.

33. The appearing limited extent of the drainage area to the storage lakes, seems to cast a doubt upon the capacity to fill the increased demand, but the

unquestioned fact that the storage reservoirs do fill and discharge quantities over their spillways, is in itself conclusive of the sufficiency of the source of supply and any attempt to elaborate upon the contributing watershed or the amounts of presipitation that fall is but a waste of time and space.